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ABSTRACT

This study explored differences between students studying introductory statistics in a strictly lecture type setting against those in an environment where the lectures are driven by computer software. A 20-item multiple-choice questionnaire was developed covering the main concepts of a first course in statistics. Included were questions on the concepts of random sampling, sampling distributions, interval estimation, hypothesis testing, and prediction using regression analysis. Two college classes in statistics that were taught without the use of statistical software (although they required the use of a calculator) and two classes of the same course where the instructors required extensive use of computer software were selected for the sample. Scores for the students who learned strictly with a lecture type format were found to be statistically insignificant from those of the students who learned with extensive computer usage. No significant differences were found between the two groups of students with regard to math anxiety, attitudes towards statistics, or previous mathematics grades. The one difference that surfaced was that students with prior computer background were more likely to select the computer-supported section. (Author/AEF)

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# Some Variables in Relation to Students' Choice Of Statistics Classes: Traditional versus Computer-Supported Instruction

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## ABSTRACT

The current study was designed to measure any differences, if they exist, between students studying introductory statistics in a strictly lecture type setting against those in a setting where the lectures are driven by computer software. A twenty item multiple-choice questionnaire was developed covering the main concepts of a first course in statistics. Included were questions on the concepts of random sampling, sampling distributions, interval estimation, hypothesis testing, and prediction using regression analysis. Two college classes in Statistics that were taught without the use of statistical software (although they required the use of a calculator) were selected and two classes of the same course where the instructors required extensive use of computer software were also selected for the sample. The scores for the students who learned strictly with a lecture type format were found to be statistically insignificant from those of the students who learned with extensive computer usage. Additionally, no significant differences were found between the two groups of students with regard to math anxiety, attitudes towards statistics, or previous mathematics grades. The one difference that surfaced was that students with prior computer background were more likely to select the computer-supported section of statistics.

# INTRODUCTION

In a previous study by the author (High, 1998), it was found that among statistics professors, 78% of them either required the students to learn a software package and use it or at least to be able to interpret computer printout from a software package. The remaining 22% of the professors made no such requirement and taught the class as a strictly lecture type class without computer input

In a study by Gratz, et al. (1993), utilizing psychology students in introductory statistics classes, it was found that there was no significant difference in attitude toward statistics between students taught by the traditional method of lecture and calculator usage and those taught by lecture and the use of a statistical software package. However, while it found no difference on a multiple-choice exam between the two types of classes, it did find that the students taught by the lecture method without computer usage outperformed the students taught using computer software on open-ended questions concerning the content of statistics.

A study by Elmore, et al. (1993) of 289 college students found no statistically significant differences between students taught with a computer requirement and those taught without the requirement for attitude towards statistics. The study did find that those taught with a computer requirement

had more positive attitudes towards the computer and less statistical anxiety at the end of the semester.

In addition to the question of using or not using computer software to supplement the teaching of statistics, there have also been many studies looking at various characteristics of the students and how their attitudes towards statistics affects their grade (see Goldstein & High (1992); Perney (1990); Sutarso (1992)).

The purpose of the present study was to determine if there was any measurable difference in overall understanding of underlying statistical concepts between the students in a strictly lecture type class and the students in a computer software assisted class.

## THE SURVEY INSTRUMENT

A twenty-item questionnaire was constructed consisting of conceptual questions relating to the material covered in a first semester course in Statistics. The questions were non-computational, based instead on determining how well the respondent understood the underlying statistical concepts, such as which distribution to use for a particular hypothesis test and how type I and II errors are related. Included were questions on the concepts of random sampling, sampling distributions, interval estimation, hypothesis testing, and prediction using regression analysis. Each question had five choices to pick from, with only one correct choice. Additionally, at the end of the questionnaire were a number of background questions including information about previous mathematics courses and grades.

At a four-year college in Long Island, New York, four sections of basic statistics were identified. The professors for two of these sections utilized statistical software (specifically the Student Version of SPSS) to supplement their teaching. The students in these classes were required to carry out a series of computer exercises and projects during the semester as part of their assignments for the class. Additionally, a part of each class was devoted to the analysis and interpretation of computer printout for various statistical problems encountered in the course. The remaining two sections were

taught by professors who did not utilize statistical software. Instead they relied strictly on lectures and homework assignments out of the textbook that the students completed with the aid of a calculator, but no computer programs.

The two classes that were taught utilizing computer software (Computer) contained 20 and 23 students for a total sample size of 43 respondents. The two classes that did not utilize or teach statistical software (Lecture) had 19 and 25 students for a total of 44 respondents. It is the 43 and 44 respondents that form the basis of analysis for the current study.

The questionnaires were distributed to the students in the four classes of Statistics during the last week of classes before final exams. It was explained to the students that this would have no bearing on their grade in the class. Additionally, they were instructed not to put their name on the paper. The questionnaires were then collected and graded, with each of the twenty questions worth five points.

## RESULTS

In the group of 43 students who were exposed to statistical software through homework assignments and classroom discussion (Computer), the mean grade on the questionnaire was 72% (71.7) with a standard deviation of 13.8.

In the group of 44 students who were not exposed to statistical software (Lecture), the mean grade on the questionnaire was 75% (75.5) with a standard deviation of 14.4.

Assuming equal variances in the two groups, the resulting t-score for the difference between the two groups is 1.22 (p is about .11) and is not significant.

The background/personal information questions were then analyzed and compared between the two groups. A Chi square test of independence was performed between the students' math average and their self-reported anticipated statistics grade. Not surprisingly, the test was significant ($p<.01$) and there was a relationship between the student's mathematics average and their anticipated grade in the statistics course. This relationship held for both types of instruction, Computer and Lecture. With respect to the question concerning when they took the class, i.e., as a sophomore, junior, or senior, the two groups were almost exactly the same in the proportion of

class standing. The mode being spring semester, junior level in college (70%). The number of spring semester seniors was low, with only 10 in both groups combined. In analyzing why the students chose either the computer-oriented version of the course or the lecture only version, the principal criterion was computer familiarity. The students who indicated that they were computer literate and enjoyed working with computers were most likely to take the computer oriented statistics section with the students indicating little, if any, computer knowledge opting for the lecture only sections of statistics. There was little, if any, association between the section chosen and the student's previous math average nor was there an association between section chosen and the self-reported level of math anxiety.

## DISCUSSION

Some professors have expressed the feeling that students tend to rely on the computer for results and never develop an appreciation of the underlying concepts needed for mastery of a first-semester course in statistics. It was this concern that led to the current study.

The study, while limited in size, focused on two groups of students, one taught by traditional methods and the other by including extensive computer usage, both with homework assignments and for classroom discussion. While a difference was found on a multiple-choice test between the two groups of students, it was not significant. Additionally, the various attitude items and personal items were very similar for the two groups. The one item of difference between the two groups was that those with a computer background were more likely to take the computer instructed section of statistics.

Most of the students were taking the class in their junior year and not postponing it to their senior year as might have been expected due to anxiety they might have felt.

From this small sample, combined with previous studies, it would appear that computer software requirements do not necessarily lead to better understanding of the underlying concepts of statistics. The criterion that students use to choose between the straight lecture course or the computer software aided course seems to be simply a prior familiarity of computers. Anxiety, attitude towards math, etc. do not appear to play a major role in the selection process.

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